

ACCESSION #: 9906220089

NON-PUBLIC?: N

LICENSEE EVENT REPORT (LER)

FACILITY NAME: San Onofre Nuclear Generating Station PAGE: 1 OF 6

(SONGS) Unit 3

DOCKET NUMBER: 05000362

TITLE: Manual Reactor Trip Due To Loss of Main Feedwater

EVENT DATE: 5/13/1999 LER #: 1999-003-00 REPORT DATE: 6/11/1999

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

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COMPONENT FAILURE DESCRIPTION:

CAUSE: SYSTEM: COMPONENT: MANUFACTURER:

REPORTABLE EPIX:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On 5/13/1999, at 2144 PDT, with the unit at 97 percent power, technicians were investigating feedwater system oscillations, when a main feedwater control valve closed. Operators manually tripped the reactor,, and started the Auxiliary Feedwater System. All control rods fully inserted. The Emergency Core Cooling System was not required and was not actuated, either manually or automatically. Plant responses were as expected.

This event was reported to the NRC pursuant to 10CFR50.72(b)(2)(ii). This Licensee Event Report is provided pursuant to 10CFR50.73(a)(2)(iv).

The cause was an "open" relay contact in the output of the Feedwater Regulation Control System which is normally closed during power operation. When this contact opens, the main feedwater regulator valve closes. The contact failed when fine debris from the relay's plastic case migrated to the contact surfaces, causing high contact resistance.

The faulty relay was replaced. As a result of this event, and that in LER 3-1999-004, SCE is evaluating its preventative maintenance program.

This event is categorized as GREEN. SCE has not reported any related events in the past 3 years.

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Plant: San Onofre Nuclear Generating Station (SONGS) Unit 3 Reactor

Vendor: Combustion Engineering

Event Date: May 13, 1999

Event Time: 2144 PST

Unit 2*_ / Unit 3

Mode: 1 1

Power (percent): 100 97

Temperature (degrees F): 538 539.3

Pressure (psia): 2250 2250

*_ /Unit 2 was unaffected by this event.

Background:

At SONGS Unit 3, condensate is supplied to the Main Feedwater System (FW)

(SJ) from the condensate system. Feedwater is directed from a common

header to three, balanced parallel-piped, low pressure sixth point heaters.

From the sixth point heaters, the feedwater flows into a common header.

The system then branches into two parallel trains of four low pressure heaters. From the low pressure heaters, the flow is directed to two turbine driven, 50 percent capacity, FW pumps (P). The FW pumps operate in parallel and discharge into two interconnected lines that flow to the first point high pressure heaters. From the first point heater, the feedwater flows through the FW regulating valves (FCV) (3FV1111 and 3FV1121) to the steam generators. See Figure 1.

Each steam generator has a separate and independent Feedwater Regulation Control System (FWRCS). The FWRCs is a three element control system (LC) (actual level, steam flow, and feedwater flow). Proper steam generator level is maintained by comparing actual steam generator level to its programmed level. A rate of change circuit utilizes any difference between steam flow and feedwater flow to adjust for system transients (shrink and swell).

Main feedwater flow rate is controlled by a combination of main and bypass control valve position, and feedwater pump speed. The main feedwater pump speed setpoint signal is a function of the larger of the flow demand signals from each of the FWRCs. At low flow conditions, the pump speed setpoint program demand signal provides for a predetermined minimum speed. As flow requirements increase, the speed of the pump is increased at a proportional rate.

Each of the main feedwater regulating valves respond to a generated

feedwater flow demand. At low power, the feedwater regulating bypass valve controls feedwater flow. At intermediate power, the main and bypass feedwater regulating valves share control of feedwater flow. At high power, the main and bypass feedwater regulating valves are essentially open and main feedwater pump speed is the primary mechanism for flow control. minimizing the pressure drop across the regulating valves.

The main feedwater regulating valves are air operated angle balanced plug valves with a piston pneumatic operator. The piston is operated by an air operated direct-acting actuator. The feedwater regulating valves are pneumatically controlled. The pneumatic control system consists of a Moore 77-16 I/P (current to pressure) converter module, a Moore 750P valve positioner, two Moore model 61 H F/R booster relays designed to meet high speed control applications, and two ASCO model HV 200-924-IU, three-way solenoid valves. The solenoid valves are operated by 120 VAC power and have their exhaust ports plugged. On loss of air or electrical signal, the actuator will lock the valve in the position it is in, causing it to fail "AS-IS."

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The feedwater pumps' design discharge pressure is 1125 psig and the pumps automatically trip on high discharge pressure at 1500 psig.

Description of the Event:

On May 13, 1999, at 2144 PDT, with the unit at 97 percent power, technicians were investigating feedwater system oscillations (see

Additional Information for feedwater oscillations on May 12, 1999), when feedwater control valve 3FV1121 closed. (Reference AR990501187) An operator (utility, licensed) attempted to take manual control of feedwater, but both feedwater pumps tripped on high discharge pressure. Control room operators (utility, licensed) recognized the condition (loss of normal feedwater), manually tripped the reactor, and manually started the Auxiliary Feedwater System. All control rods fully inserted. The Emergency Core Cooling System (ECCS) was not required and was not actuated, either manually or automatically. Plant responses were consistent with and were bounded by the transient analysis provided in UFSAR Chapter 15. This event was reported to the NRC Operations Center (Log No. 35713) pursuant to 10CFR50.72(b)(2)(ii). This Licensee Event Report (LER) is provided pursuant to 10CFR50.73(a)(2)(iv).

Cause of the Event:

Troubleshooting discovered an "open" relay contact in the output of the FWRCs (DeVar Module #19-506-4 in 3L049 E-4) which was expected to be closed. The module was removed and the failure of the contact from terminals 13 & 14 was duplicated in the shop. This relay contact, which is closed during power operation, provides the control signal to the valve positioner. If this contact opens due to operational program demand or a relay failure, the main feedwater regulator valve will close.

The contact failed when fine debris from the relay's plastic case migrated to the relay contact surfaces by static electric charge attraction. The

debris is the result of normal aging over a long period of time (approximately 19 years). This debris causes high contact resistance which, if high enough, would result in an open circuit (zero output from the control system), causing main feedwater regulating valve 3FV1121 to close.

The technicians (utility, non-licensed) working in the FWRCS cabinet at the time this event occurred did not cause the event. However, the normal jarring of the relay caused by opening the cabinet, or by taking electrical measurements, could reasonably have caused the relay contact mating surfaces to shift introducing resistance from the debris into the circuit, triggering the event.

Corrective Actions:

- o The faulty relay was replaced. 3FV1121 was stroked satisfactorily a number of times. 3FV1121 responded as expected when the relay was energized and de-energized. The valve closed when its relay was de-energized, and opened when the relay was re-energized. Final functional testing of 3FV1121 was completed satisfactorily.
- o Similar relays in the feedwater control circuits for 3FV1111 and Unit 2's 2FV1111 and 2FV1121 will be replaced at the next suitable opportunity.

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- o As a result of the event reported herein, and the separate event reported in LER 3-1999-004, SCE is evaluating its preventative

maintenance program for the FWRCs.

Safety Significance:

This event was evaluated using the NRC's draft Significance Determination Process (SDP). Auxiliary Feedwater System was manually initiated. The reactor was manually tripped and all control rods fully inserted. The Emergency Core Cooling System (ECCS) was not required and was not actuated, either manually or automatically. In accordance with the SDP, this event affected only one cornerstone - Initiating Event. Because this condition did not contribute to either the likelihood of a Primary or Secondary system LOCA initiator or the likelihood that mitigation equipment would not be available, no Phase 2 or 3 review was required. This event is categorized as GREEN.

Additional Information:

A. On May 8, 1999, at approximately 1500 PDT, during unit startup from the Cycle 10 refueling outage, 3FV1121 did not stroke from closed to open on the first attempt. The regulator bypass valves and the other feedwater regulating valve 3FV1111 stroked normally. During a second attempt, 3FV1121 stroked normally. Startup of the unit proceeded. This spurious behavior was likely caused by the same mechanism (fine debris on the contact surface) as the event reported herein.

B. On May 12, 1999, operators noticed that:

1. 3FIC1111 output was 67 percent and 3FIC1121 was 77 percent while at approximately 90% power. This caused less than optimum main

feedwater control.

2. Both main feedwater regulator valves unexpectedly went to the normal, expected 70 percent open. The resulting feedwater now perturbation caused both SG levels to oscillate, but the FWRCS stabilized both steam generator levels with no operator intervention. When the oscillations were over, the system was behaving normally.

It was during the investigation of this that the Unit trip reported herein occurred. The cause of this could not be determined conclusively. However, both can be explained by either 1) the cause of the event reported herein (high contact resistance caused by fine debris on the relay contact), or 2) the cause of the event reported in LER 3- 1999-004 (faulty main feedwater regulator valve positioner), or a combination of these two.

It should be noted that the FWRCS is normally "tuned" during startup from a refueling. The tuning, which is completed at full power, was still in progress at the time. Therefore, the system's performance was not optimum and could have contributed to the observed feedwater flow perturbation.

C. On May 14, 1999, during pre-startup valve stroking operations, the four valve actuator hold down cap screws on 3FV1 121 were discovered to be broken or cracked. Failure analyses of the cap screws determined the four cap screws had loosened during operation because

of normal system vibration. The loosened cap screws then cracked by fatigue and two ultimately broke under bending stress. The cracked and broken cap screws were unlikely to have been caused by either the event reported herein or in LER 3-1999-004. However, the loose actuator could have contributed to main

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feedwater control problems by causing a mismatch between valve position and positioner demand.

The four stainless steel cap screws were replaced with higher tensile strength carbon steel cap screws. The carbon steel cap screws are less susceptible to fatigue failure. Similar valve actuator cap screws on Units 2 and 3 were inspected. All the cap screws were tight, but their condition (cracking and torque) were not be determined during plant operation. 2FV1111 has stainless steel cap screws, which will be replaced with carbon steel cap screws at the next opportunity.

D. In the past three years, SCE has reported the following ESF actuations:

1. LER 3-1999-004 reported a manual reactor trip when feedwater regulating valve 3FV1111 failed open, over-feeding a steam generator. The cause of that failure was an air leak from the valve's positioner, a cause different than reported herein. The corrective actions for that event would not

have prevented the event reported herein.

2. LER 2-1999-001 reported the start of an emergency diesel generator on the loss of voltage on the 4.16 KV emergency bus. However, the causes (human error in combination with a transformer ground which had been installed for planned maintenance) were different from the event reported herein, and the corrective actions taken could not have prevented the event reported herein.

3. LER 2-1998-017 reported the manual isolation of the control room air intake by actuating the control room Toxic Gas Isolation System (TGIS) when an operator detected the faint odor of chlorine. The cause was a sulfuric acid storage tank leak. While the cause of the leak was equipment failure, that event and the one reported herein are not related, and the corrective actions taken for the acid leak could not have prevented the event reported herein.

4. LER 3-96-001-01 reported the automatic start of both emergency diesel generators on a loss of voltage signal on the emergency bus. The signal was caused when a Test Technician inadvertently actuated a relay. The cause (human error) was different from the event reported herein, and the corrective actions taken could not have prevented the event reported herein.

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Figure 1 "Main Feedwater Flow Diagram" omitted.

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